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ENERGY AND ENVIRONMENT PROGRAMME

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NIAS Policy Brief

Transition Plan for Thermal Power Plants in India

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The question

Coal-based Thermal Power Plants (TPPs) constitute 56% of the total installed capacity and generated 72% of the electricity during FY 2019-20. India's proven coal reserves are sufficient to fuel the country's need for thermal power generation for several decades. Therefore, the predominance of coal-fired power generation in India will continue for several years to provide energy security and drive economic growth. Particulate Matter (PM) pollution from TPPs is a major concern in many parts of India even as the ambient concentrations of Sulphur-di-Oxide (SO_2) in the atmosphere around TPPs using Indian coals are well within the National ambient air quality standards. In December 2015, the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India (GoI), notified the Environment (Protection) Amendment Rules (EPAR 2015) *inter alia* to reduce stack emissions of SO_2 from TPPs by retrofitting Flue Gas Desulphurisers (FGDs) by 2017. It was estimated that capital investments of the order of Rs.80,000 crores are required to retrofit FGDs in existing TPPs to comply with the stack emission limits for SO_2. In the prevailing scenario of financial stress in the power sector, can a transition plan be developed to achieve an optimal electricity source mix for the country?

The issue

The gestation period to retrofit FGDs in existing TPPs to comply with the stack emission limits for SO_2 varies from 24 months to 36 months. This is due to the dependence on a limited number of foreign entities for technology transfer and supply of 55 – 70 percent of the critical equipment. Therefore, the Honorable Supreme Court of India extended the deadline for the installation of FGDs in TPPs located beyond the vicinity of the National Capital region to December 2022.

As per the Central Electricity Authority (CEA) report on FGDs, as of June 2020, out of the 441 TPPs mandated to install FGDs, only four have installed FGDs till May 2020. While 100 TPPs (including 73 GOI-controlled plants) have ordered FGDs, even some of these orders are being reviewed since Indian manufacturers also import a majority of the critical components from China. Considering the time required to design, manufacture, install, and commission

the FGDs in existing TPPs and the ongoing COVID 19 pandemic, 340 TPPs in India are not in a position to meet the 2022 deadline set by the Honorable Supreme Court. Therefore, the Ministry of Power (MoP) has informed MoEFCC that, "*70% of thermal power stations will miss the December 2022 deadline and have sought extension of the target date by two years to December 2024 citing the unavailability of domestic power equipment and the lack of finance amid the Covid-19 pandemic as issues in meeting the December 2022 deadline*."

As per NTPC Ltd.'s submission to the Central Electricity Regulatory Commission (CERC), an additional investment of Rs. 70 - 80 Lakhs per megawatt (MW) of installed capacity is required to comply with the new emission norms. Specifically, retrofitting of an FGD will increase the auxiliary power consumption of a TPP by 1.7 – 2 percent with a corresponding rise in its specific coal consumption and CO_2 emissions. FGDs also impose additional costs to operate and maintain the system and increase the water consumption of TPPs. Finally, the shutdowns of operating TPPs to retrofit FGDs will result in revenue losses for already stressed power Generation Companies (GENCOs). Therefore, retrofitting FGDs in operating TPPs will increase the power procurement costs for electricity Distribution Companies (DISCOMS) and force them to hike power tariffs.

While GoI-controlled NTPC Ltd. may have the funds to retrofit FGDs in their TPPs, the financial health of State Utilities and IPPs do not permit them to make these costly investments. This is because the State governments are already struggling in an economy that may take two years to recover from the COVID-19 crisis while the GENCOs are saddled with Rs.1.2 Lakh Crores of overdue payments from the DISCOMs. Several operating TPPs may have to be shut down in an unplanned manner, if the deadline of December 2022 is not extended by GOI.

Retrofit of FGDs to limit SO_2 emissions will cause collateral damage on the environment such as incremental mining and transportation of limestone, additional water consumption, burning of more coal to meet the enhanced auxiliary power requirement, and generation of Gypsum (a by-product with heavy metals) which creates issues related to waste disposal. FGD equipment being procured by TPPs in India also involve forex outflows to the tune of Rs.40,000 crores. Last but not the least, FGD operations will also enhance specific CO_2 emissions thereby negating the success of several GENCOs in reducing specific CO_2 emissions by using supercritical technology which is mandatory for all TPPs set up from 2017 onwards.

The findings

The findings from our analysis are given below:

- FGDs are envisaged to limit SO_2 emissions from TPPs. However, the Sulphur content of domestic coals used in TPPs (0.4 – 0.7%) in India is generally lesser than that

Environmental Benefits of implementing Transition Plan for the Southern Region

Parameters	Base 2018-19	Retirement 2022	Addition 2022	Projected 2022	Savings
Coal + Lignite Consumption (MT)	**136**	**49.7**	**28.2**	**114.6**	**16%**
Coal Consumption (MT)	118.8	38.59	28.2	108.41	
Lignite Consumption (MT)	17.29	11.15	0	6.14	
Generation Total (GWh)	224,267	46,945	47,282	224,604	
Generation Coal TPPs (GWh)	205,075	34,561	47,282	217,796	
Generation Lignite TPPs (GWh)	19,192	12,384	0	6,808	
CO_2 Emissions (MT)	**191**	**67.1**	**39.8**	**163.8**	**14%**
Water consumption (Mi. Liters)	**800,475**	**253,885**	**139,124**	**685,714**	**14%**
Sp. Fuel consumption (kg/kWh)	**0.607**	**1.060**	**0.596**	**0.51**	**16%**
Sp. Coal consumption (kg/kWh)	0.579	1.117	0.596	0.498	
Sp. Lignite consumption (kg/kWh)	0.901	0.900	0	0.902	
Specific CO_2 Emission ('000 T/kWh)	**0.852**	**1.428**	**0.843**	**0.729**	**14%**
Specific Water consumption in Coal & Lignite TPPs (m^3/MWh)	**3.57**	**5.41**	**2.94**	**3.05**	**14%**
Savings in FGD/ESP Retrofit CAPEX for 4 State GENCOs in SR, Rs. Cr.	**8,037**	**4,538**			**3,499 Crores**

of imported thermal coals (~ 1%). In contrast, TPPs in the USA also use bituminous coals with Sulphur contents exceeding 1.5% thereby necessitating the use of FGDs (called "Scrubbers").

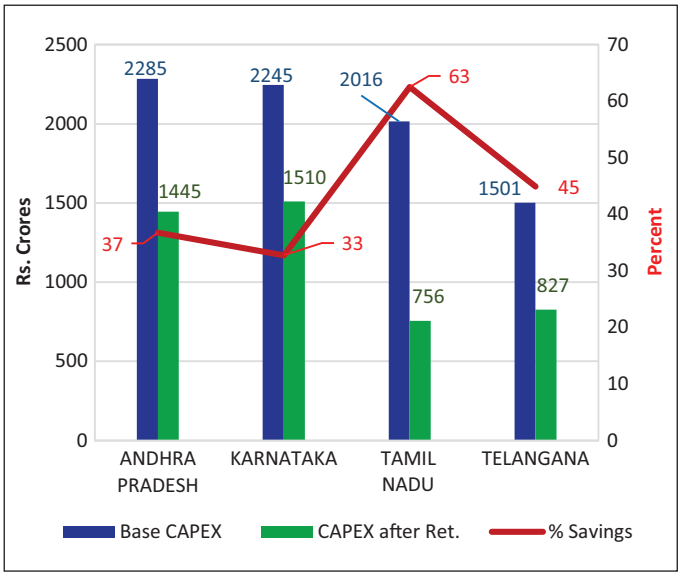
- The Central Pollution Control Board (CPCB) has mandated a minimum stack height of 275 meters for a TPP with a capacity of 500 MW (and above) and 220 meters for a TPP with a capacity of 200 – 500 MW. These minimum heights were determined by conducting field studies to determine the mean mixing depth under the climatological conditions prevailing in India which are quite different from those prevailing in the USA, Europe, and China. As a result, TPPs using Indian coal and complying with the minimum limits for stack height and exit velocity of flue gases specified by MoEFCC have succeeded in limiting the ambient SO_2 concentrations in their buffer zones well below the 24-hour standard of 80 µg/m^3.

One of the key reasons for high PM pollution from TPPs is the high ash content (generally, 30%-45%) of Indian coal compared to imported thermal coal (< 15%). The share of lower grades of coal in India's coal production has increased over the years since the share of opencast mining has increased from 77% to 94% in the last 20 years. Using washed coal to reduce the ash content of coal used in TPPs leads to consistent performance as well as reduced emissions. The key economic and environmental benefits of using washed coal in TPPs in India have been documented in several studies as follows:

- Lower carbon emissions per unit of power generated due to enhanced thermal efficiency.
- Reduction in SO_2, NO_2, and PM emissions due to the higher calorific value of washed coal.
- Drop in air pollution during coal transportation since lesser quantity of washed coal has to be transported per unit of electricity generated.
- Cutback in land required for ash ponds thereby lowering the risk of water pollution due to ash dam failures.
- Higher power generation due to lower downtime and consistent coal quality.
- Decline in operating and maintenance costs and auxiliary power consumption in TPPs.
- Savings in energy charges due to the reduction in coal transportation costs per unit of power.

Coal washing can also reduce the inorganic Sulphur (in the form of pyrites) content of coal as documented by the Environmental Protection Agency in the US. The World Bank has also recommended prioritizing the use of washed coal along with sorbent injection (with lime or crushed limestone) to absorb the SO_2 in the flue gas before considering

Savings for State GENCOs by adopting Transition Strategy



in-stack removal of SO_2 in TPPs burning low-Sulphur coals. TPPs can use a combination of cost-effective clean coal technologies like coal washing and sorbent injection along with high-performance Electrostatic Precipitators (ESPs) to control PM and SO_2 emissions without major capital investments and tariff hikes to pay for them. On the other hand, retrofitting existing TPPs with FGDs based on imported technology will require extended shutdowns, higher coal and water consumption, an increase in operating and waste disposal costs, and enhanced CO_2 emissions in addition to major capital investments.

The interventions

A technically feasible and cost-effective "Transition Plan" for the power sector in the Southern Region (SR) has been developed which will result in a more environment-friendly power sector by 2022. This transition plan consists of the following steps:

- MoP and State Governments to work together to implement an "End of Life" policy to progressively retire 47 sub-500 MW TPPs (with a total capacity of ~8000 MW) in SR which will complete 25 years of service by December 2022;
- The power generated from 10 High-Efficiency, Low Emissions (HELE) TPPs and one 500 MW nuclear power plant with a cumulative capacity of 6350 MW that are currently under construction in the SR can offset the non-availability of electricity from the TPPs proposed for retirement.
- The balance power required to meet the peak demand can be procured from other under-utilized HELE TPPs in India through the National Power Grid which is also undergoing a rapid expansion to meet the future power demand of the SR.

As shown in the figure, implementation of this transition plan will help the four State GENCOs in SR to save Rs.3500 Crores in retrofit costs which they will otherwise spend on making their +25-year old TPPs compliant with EPAR (2015). Besides, implementation of this transition plan will lower specific coal consumption and reduce specific CO_2 emissions of these GENCOs by 14 percent and also cut down specific water consumption by 16 percent (Table). Therefore, FGD retrofits in existing sub-500 MW TPPs must be mandated only if they are located in urban/sensitive/ critically polluted areas.

Extending this scenario to the four major regions of the country (NR, SR, WR, and ER), it is recommended that 162 TPPs (27,129 MW) be retired in phases by 2022-23 since 38 HELE TPPs with a combined capacity of 21,240 MW and NPPs with a capacity of 1900 MW will be commissioned by 2022-23. Implementation of this transition plan will help the State GENCOs of the four regions to save Rs 15,460 crores in FGD retrofit costs besides realizing overall savings of 9% in specific fuel and water consumption, and a 7% reduction in specific CO_2 emissions.

The implementation of these recommendations for a Transition Path for TPPs together with the expeditious installation of indigenous pollution control measures, such as coal beneficiation, sorbent injection, and high-efficiency ESPs in all TPPs will not only help the power sector to breathe easy but also embody the true spirit of *Atmanirbhar Bharat*.

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